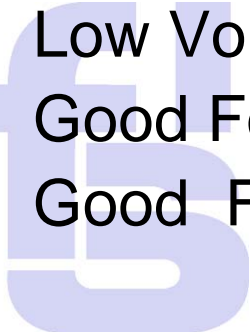

ecomate[®]

**Solução definitiva em agente de
expansão ecologicamente correto**

FEIPUR - BRAZIL 2006

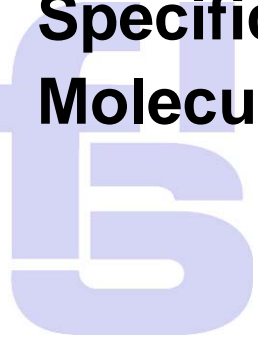
ecomate® advantages

- A LIQUID Physical Blowing Agent
 - Patented: US, Australia, Singapore w others Pending
 - Thermally Efficient Insulation
 - To Replace HCFC's, HFC's, HC's
 - **ENVIRONMENTALLY BENIGN**
 - ZERO **ODP**, ZERO **GWP**, **VOC** Exempt [US EPA]
 - Economically Advantageous – Use less!
 - Excellent Solubility
 - Low Volatility – Non-flammable Mixes
 - Good Foam Properties
 - Good Foam Flammability Resistance
- 
-

ecomate[®] Blowing Agent Properties

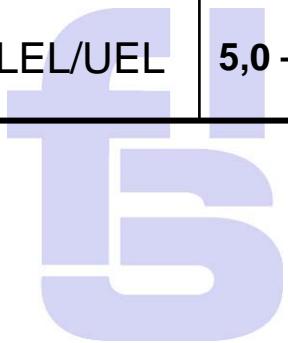
- **Clear, Colorless, Flammable Liquid**

▪ Boiling Pt	88.7 F	31,5 C
▪ Flash Point	-26 F	-32 C
▪ LEL \ UEL	5 - 23%	5 - 23%
▪ LAMBDA, gas (25 °C)	0.074	10,7
▪ Vapor Pressure (25 °C)	11.4 psia	586 mm
▪ Auto Ignition Temp	>840 F	>450 C
▪ Specific Gravity	0.982	0,982
▪ Molecular Weight	60	60

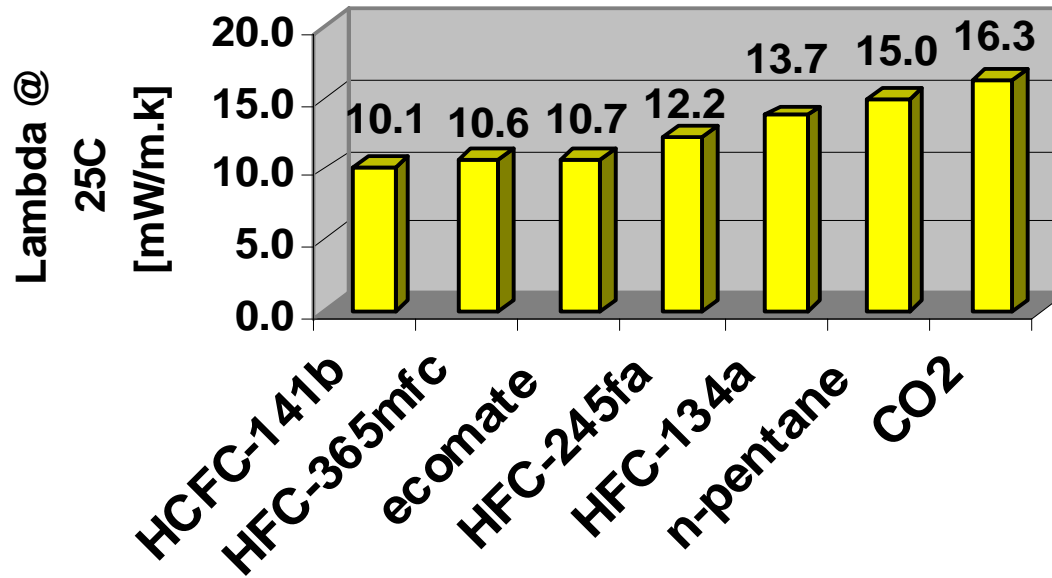


BA COMPARISON

	ecomate	141b	245fa	365mfc	365/227 93 / 7	n-C5	cC5
Mol wt	60	117	134	148	149,6	72	70
Bpt, C	31,5	32	15,3	40,2	30	36	49
Sp Gr	0,982	1,24	1,32	1,25	1,28	0,62	0,75
Lambda	10,7	10	12,2	10,6	10,7	14*	11*
LEL/UEL	5,0 – 23,0	7,6 – 17,7	n/a	3,5 – 9,0	3,8 – 13,3	1,4 – 17,8	1,4 – 8,0



GAS LAMBDA VALUES



ecomate[®] Blowing Agent

- Environmental Characteristics

- ecomate blowing agent is an attractive long term environmental option

	ODP	GWP	VOC
CFC 11	1	4000	NO
CFC 12	1	8500	NO
HCFC 141b	0.1	630	NO
HCFC 22	0.05	1700	NO
HCFC 142b	0.06	2000	NO
HFC 365	0	840	NO
HFC 134a	0	1300	NO
HFC 245fa	0	790 -1040	NO
Cyclopentane	0	11	YES
ecomate	0	0	NO




Cost Efficiency

Blowing Agent	Mol Wt	Factor
HCFC-141b	117	1.00
HFC-245fa	134	1.15
HFC-365/227	149	1.27
cC5	70	0.60
nC5	72	0.62
ecomate®	60	0.51

Cost Efficiency

Blowing Agent	Mol Wt	Factor	\$/LB
HCFC-141b	117	1.00	**
HFC-245fa	134	1.15	*****
HFC-365/227	149	1.27	****
cC5	70	0.60	**
nC5	72	0.62	*
ecomate®	60	0.51	**



ecomate®

Cost Efficiency

Blowing Agent	Mol Wt	Factor	\$/LB	\$/mole
HCFC-141b	117	1.00	**	Ref
HFC-245fa	134	1.15	*****	+350%
HFC-365/227	149	1.27	****	+380%
cC5	70	0.60	**	- 45%
nC5	72	0.62	*	- 70%
ecomate®	60	0.51	**	- 65%

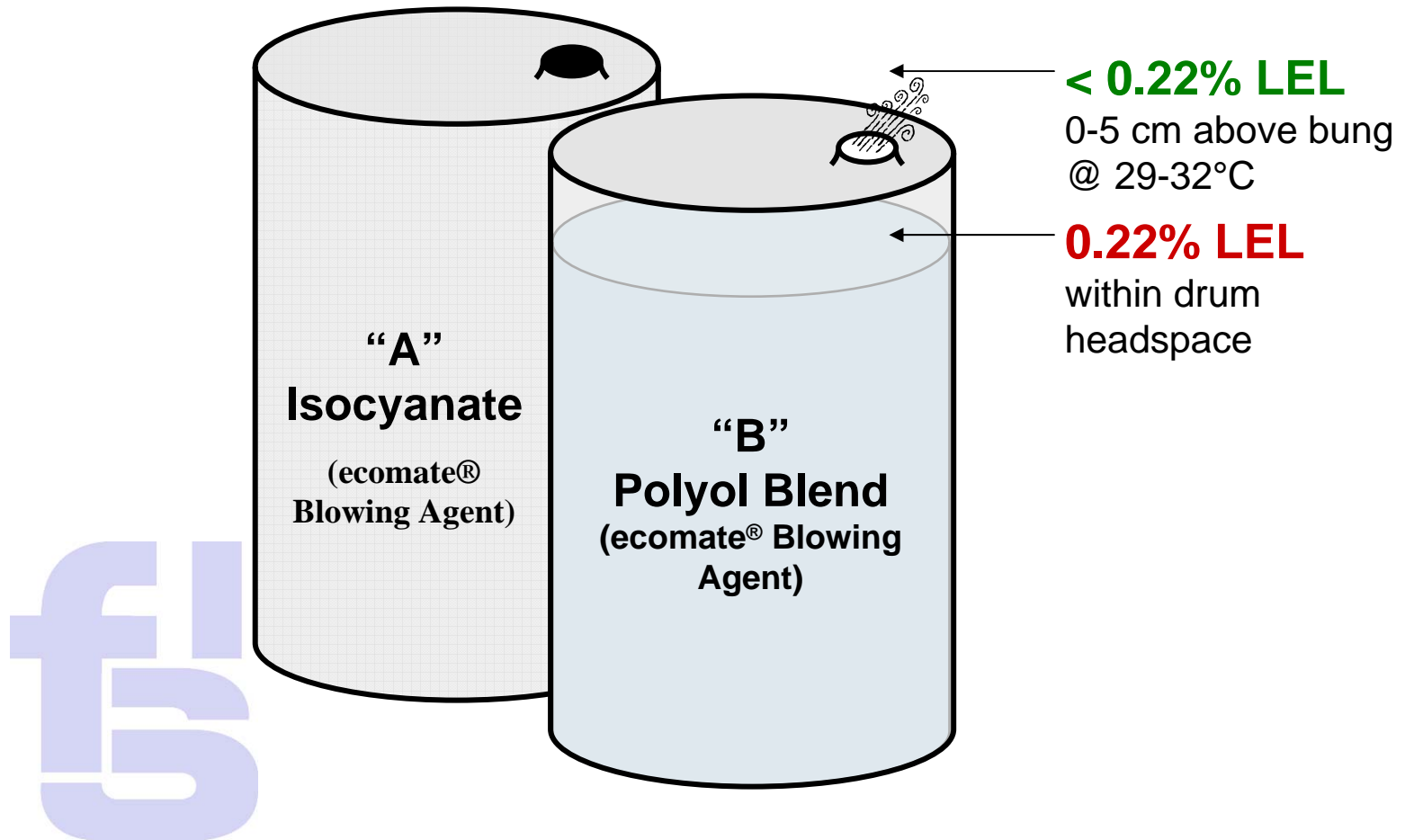
ecomate[®] Solubility

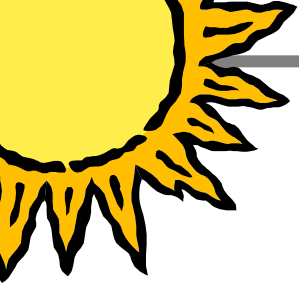
- **Excellent solubility** in all foam ingredients



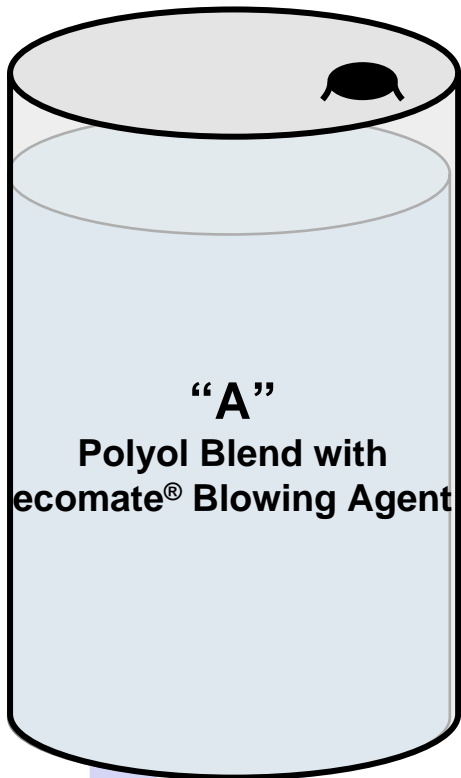
CHEMICAL	ASPECT w 20% ECOMATE
POLYESTER polyol	CLEAR
SUCROSE GLYCERIN polyol	CLEAR
AMINE polyol	CLEAR
MANNICH polyol	CLEAR
ISOCYANATE	CLEAR
DEG	CLEAR
TCPP	CLEAR
Br FRA	CLEAR
PROP CARBONATE	CLEAR
WATER	CLEAR

ecomate[®] System Emissions – Stored Systems in Drums/Totes

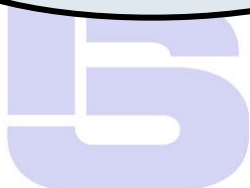
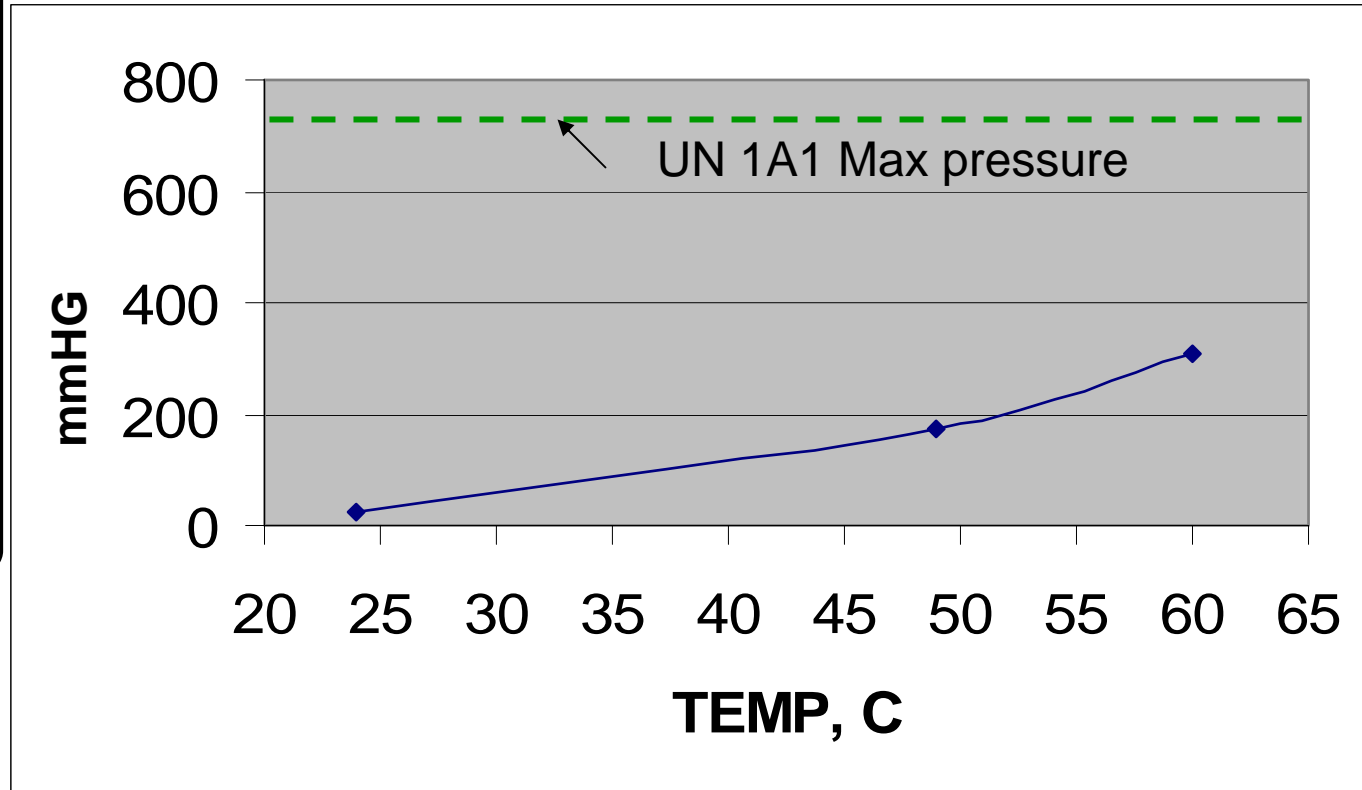


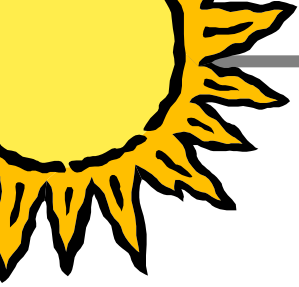


Vapor Pressure of Stored **ecomate**[®] Blends

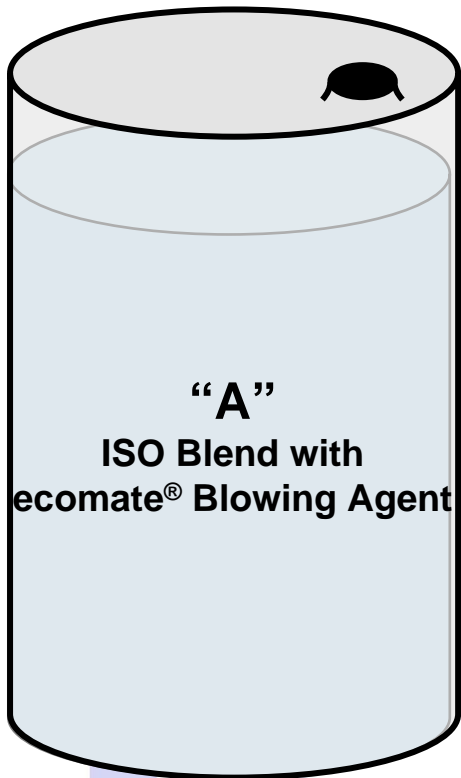


Vapor Pressure (ASTM D2879, typical data)
Blowing Agent/Polyol System
eco3-95-1.7

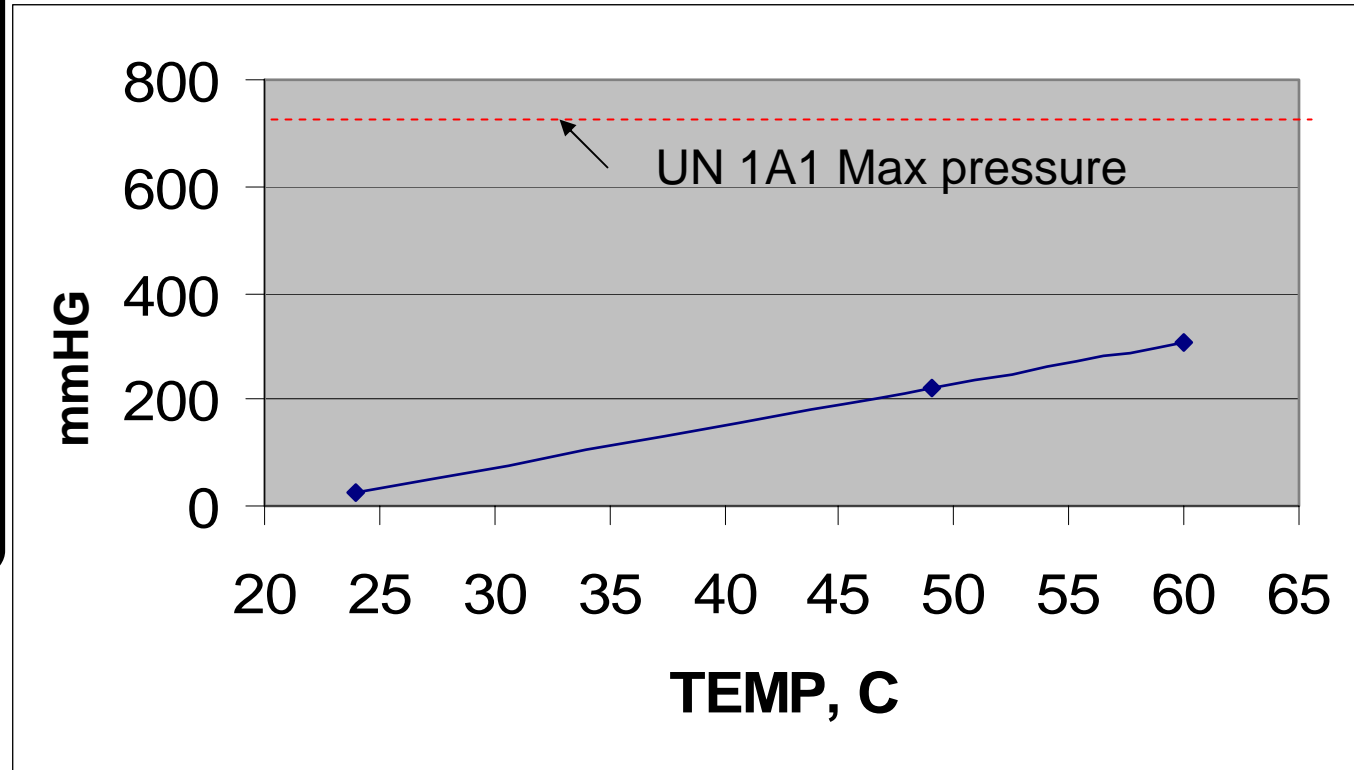




Vapor Pressure of Stored **ecomate**[®] Blends

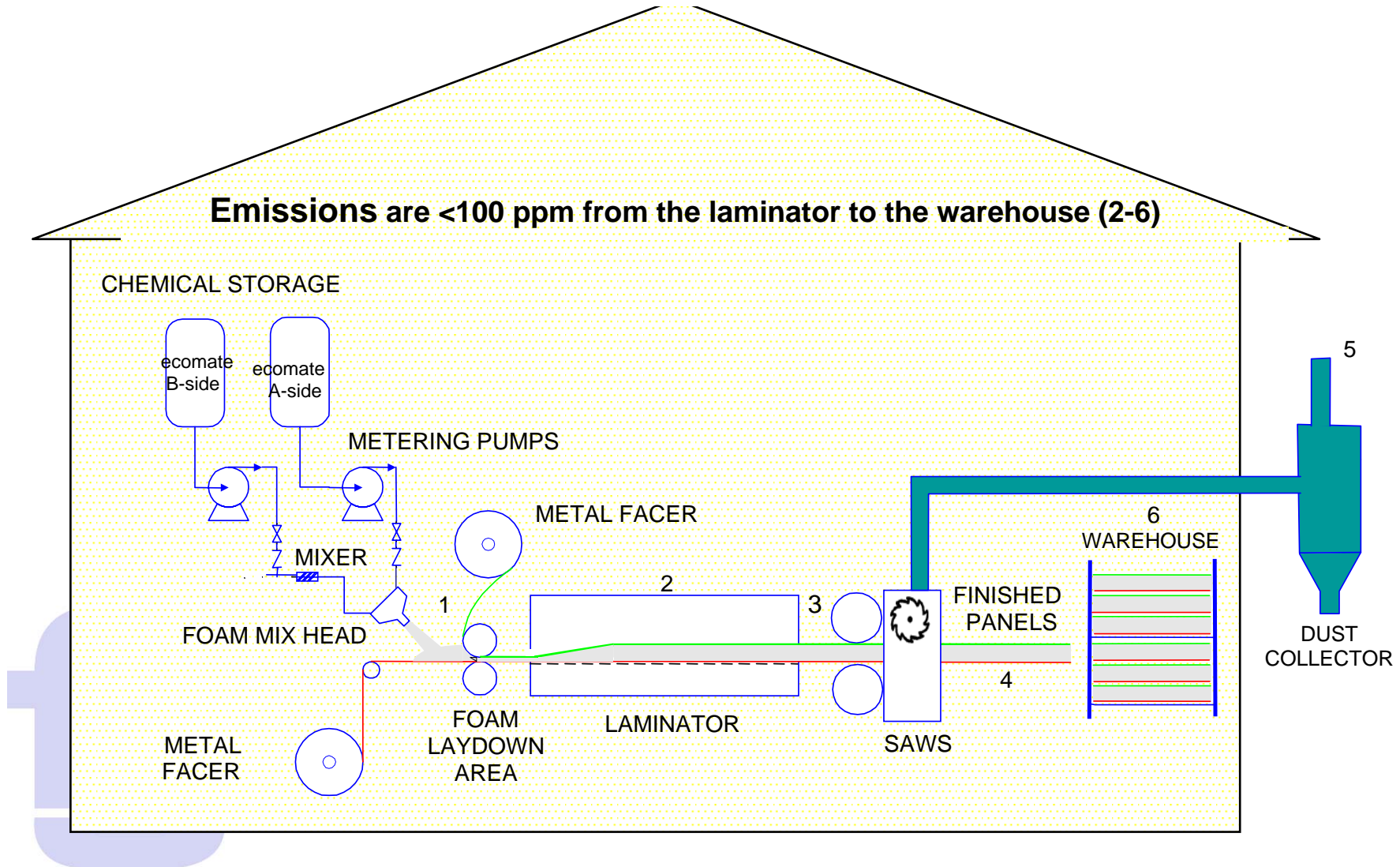


Vapor Pressure (ASTM D2879, typical data)
Blowing Agent / Isocyanate System
eco3-95-1.7



ecomate[®] System Emissions

Emissions are <100 ppm from the laminator to the warehouse (2-6)



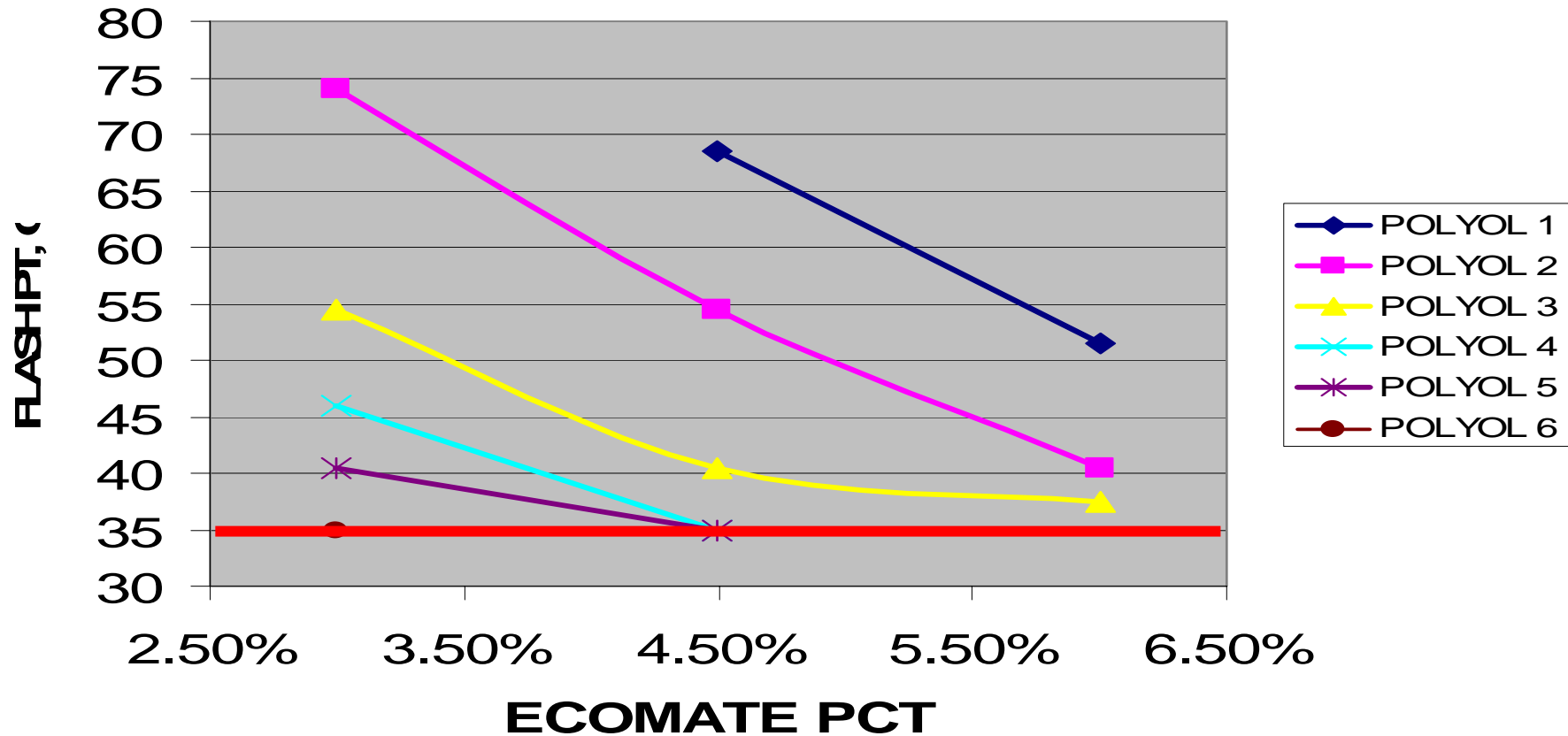
Potential Challenges

- Flash Point
- Hydrolysis
- Toxicity
- Foam Properties

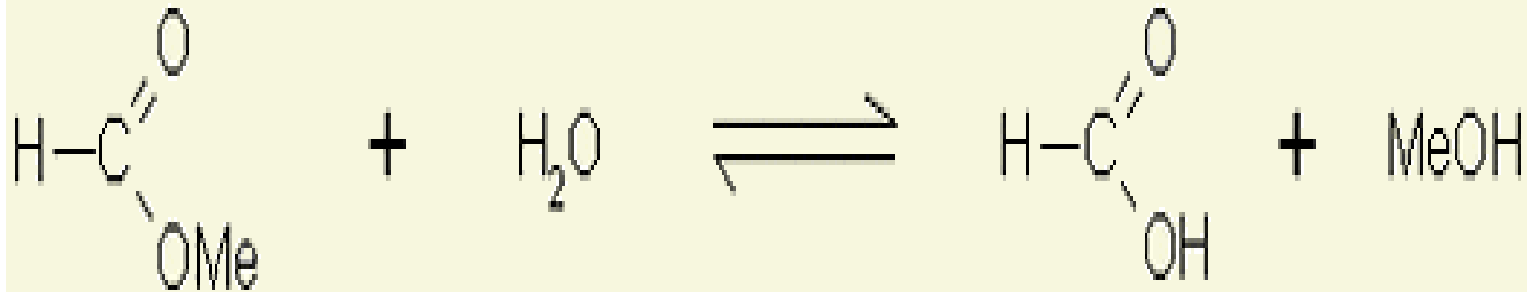


System Flash Point

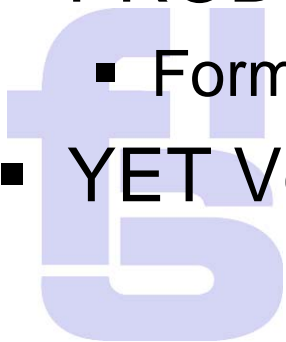
POLYOL TYPE



HYDROLYSIS



- ESTER HYDROLYSIS
- PRODUCTS:
 - Formic Acid & Methanol
- YET Very Stable in Systems: 1+ yrs on shelf



Toxicity

U.S.EPA HPV Chemical Challenge Program Revised Test Plan for the Formates Category

Formic Acid*	CAS#: 64-18-6
Sodium Formate	CAS#: 141-53-7
Calcium Formate	CAS#: 544-17-2
Methyl Formate	CAS#: 107-31-3

Submitted by: American Chemistry Council
Formic Acid and Formates Panel
Submitted to: U.S. Environmental Protection Agency

Prepared by: Elmer Rauckman, PhD,
DABT Toxicology and Regulatory Affairs
Freeburg IL 62243


May 27, 2003

* Formic Acid is being reviewed as an ICCA chemical and is not formally a HPV chemical.

<http://www.epa.gov/chemrtk/formates/c13438rt.pdf#search='methyl%20formate'>



Toxicity

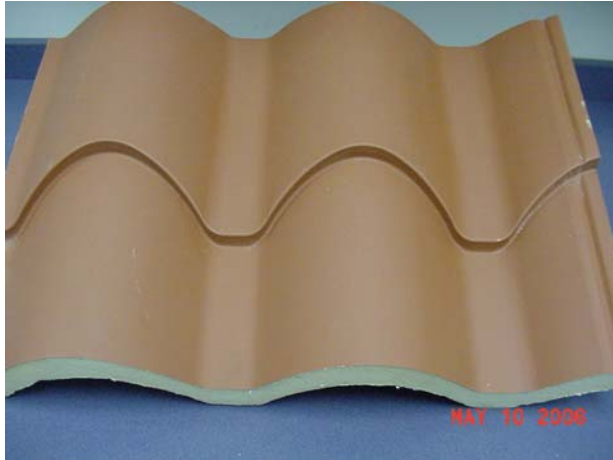
- The **acute toxicity** of all Formate materials is **low** with no special hazards
 - **Methyl Formate [MF] is transformed very rapidly into formic acid and methanol in the body**
 - with a half-life on the order of several seconds.
 - **MF is present in many foods (18)**
 - e.g., fruits (20 -40 ppm),
 - fruit juices (30 -100 ppm),
 - fruit syrups (650 -1630 ppm),
 - honey (20 -2000 ppm),
 - wines (1 -340 ppm),
 - coffee, roasted (1350 -2200 ppm),
 - coffee, extracts (2000 -7700 ppm),
 - evaporated milk (30 -400 ppm), and
 - cheese (20 -200 ppm) (19). (20). (page 14)
 - The 4-hour **inhalation LC50** of methyl formate was **> 21 mg/L**
 - All found **negative** in the **Ames test**
 - No further testing is recommended. (page 27).
- 
-

Use in Foams

- Rigid
 - Pour
 - Spray
- Integral Skinned
- Flexible



Rigid Applications



- Moulded Roof Panels
- Pipe-in-Pipe Insulation
- Spray Foam



Physical Properties

POUR SYSTEMS

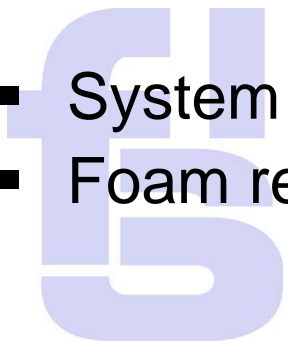
- Very Good Properties

PROPERTY	ecomate 3-95-1.7 37 kg/m ³	ecomate 2-90-1.7 34 kg/m ³
CS//, kPa	317	283
CS_ _, kPa	214	186
DIM STABS		
COLD, 7d	-0.06 %	-0.06 %
HUMID, 7d	2.0 %	-0.21 %
Lambda	20.9	20.1



POUR FOAMS

- **ecomate** system gets HIGHEST Fire Resistance
 - FSI's **eco1** System
 - **UL 723** – 25 FS / 300 Smoke - 30 – 42 kg/m³ core @ 15 cm
 - 15 FS / 65 Smoke – AL skins [9 - 14 cm]
 - 20 FS / 300 Smoke - Steel skins [9 - 14 cm]
 - **FM 4880** – Lg. Scale Corner Test – Passed
- **ecomate** excellent for PIR Boardstock
 - Laminator approval obtained.
- System shipping possible w/o 'Flammable' tags
- Foam recycling / disposal w/o environmental impact.



SPRAY FOAM

- Like other foams – except:
 - Faster Reacting
 - Prolonged Shelf Stability > 3 mos.
 - 1:1 by volume
 - Uncontrolled Application Environment

- Two routes
 - PUR & PIR



SPRAY FOAM

- Blended polyols
 - Ester - Cost & Fire Properties
 - Amine - Reactivity & Can Stability
 - Mannich - Adhesion & Can Stability
 - Sucrose - Strength & Char

- What is the Best Combination ?



D-Optimal Mixture

DESIGN EXPERT 6.0

- DMT ESTER, 184 Eqwt
 - MANNICH, 178 Eqwt
 - SUCROSE, 152 Eqwt
 - AMINE, 94 Eqwt
- 20 – 50 Parts
 - 20 – 40 Parts
 - 0 – 30 Parts
 - 0 – 25 Parts



D-Optimal Mixture

DESIGN EXPERT 6.0

- DMT ESTER, 184 Eqwt
- MANNICH, 178 Eqwt
- SUCROSE, 152 Eqwt
- AMINE, 94 Eqwt
- 20 – 50 Parts
- 20 – 40 Parts
- 0 – 30 Parts
- 0 – 25 Parts
- FIRE RETARDANT
- 15 Parts
- **ecomate**
- 6 %
- WATER
- 2.5 %



D-Optimal Mixture

DESIGN EXPERT 6.0

- DMT ESTER, 184 Eqwt
- MANNICH, 178 Eqwt
- SUCROSE, 152 Eqwt
- AMINE, 94 Eqwt
- 20 – 50 Parts
- 20 – 40 Parts
- 0 – 30 Parts
- 0 – 25 Parts
- OPTIMIZED [DESIGN EXPERT]
 - ESTER 50
 - MANNICH 21
 - SUCROSE 29
 - AMINE 0
- **45 FS / 400 SMOKE**



SPRAY FOAM

- **GOOD PROPERTIES**
- **CLASS 1 & 2 FLAMMABILITY**
- **3+ MOs STABILITY**



Integral Skin



Integral Skin

- **ecomate** – best alternative to 141b
- Solvates all Raws currently used
- BPt. just above ambient [like 141b]
 - Permits good skin formation
 - Allows fast demold times
- Environmentally Benign
- Economical – Mol Wt **HALF** of 141b
- US EPA SNAP Approved



Flexible Foams


Molded & Slab



- Good Solubility
- Fine Cells
- Safer than MeCl_2 ,
Acetone
- Non-VOC
- Excellent Hand
- Can use MDI



Toxic Effects

- Long Term Animal Studies - ACETONE
 - Kidney Damage
 - Liver Damage
 - Nerve Damage
 - Increased Birth Defects
 - Lowed Reproduction [Males]
 - Long Term Animal Studies – MeCl₂
 - Cancer of Lungs, Liver, Pancreas
 - Fetal Toxicity [Females]
- 

Flexible Foams

Molded & Slab

	Ecomate	Acetone	MeCl ₂
Mol Wt	60	58	85
B Pt, °C	32.1	56.3	40
LEL, vol%	5	2.5	12
UEL, vol%	23	12.8	23
Heat of Vaporization, cal/g	112.4	130	78.9 CARCINOGEN
PEL, ppm	5000	1000	25
TLV, ppm	100	500	50

Flexible Foams


Molded & Slab

	Ecomate	Acetone	MeCl ₂
Mol Wt	60	58	85
B Pt, °C	32.1	56.3	40
LEL, vol%	5	2.5	12
UEL, vol%	23	12.8	23
Heat of Vaporization, cal/g	112.4	130	78.9 CARCINO GEN
PEL, ppm	5000	1000	25
TLV, ppm	100	500	50


Ecomate

- Lower GWP
- Lower HtVap = Lower Dens
- Safer to Use
 - MeCl₂ = Carcinogen
 - 2x higher LEL = SAFER
 - 5x higher PEL = SAFER
 - 1/5 lower TLV = SAFER
- No Baggage – Now or Future!

CONCLUSIONS

- **SPRAY**
 - **GOOD PROPS, CLASS 1 & 2, 3+ MOs STABILITY**
 - **POUR**
 - **EXCELLENT PROPS, HIGH FIRE RESISTANCE**
 - **INTEGRAL SKIN**
 - **ecomate - a perfect fit**
 - solubility,
 - ideal BPt,
 - Lo MW,
 - environmentally benign
 - **SLABSTOCK**
 - All the above
 - Safer than Acetone, MeCl₂
- 
-

ecomate[®] advantages

- A True **LIQUID** Blowing Agent
 - Good Solubility
 - Low Volatility
 - Good Foam Properties
 - Good Flammability Resistance
 - Cost Competitive
 - **BENIGN** to **ENVIRONMENT**
 - No Future Baggage!
- 
-

Contacts – S/C America

- **PURCOM Quimica Ltda**
- Gerson Silva
- Rua Aeroporto n° 83/115
- 06419 260 Barueri, SP, BRAZIL
- TEL:(+55 11) 4168 2829



Contacts - EUROPE

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- Zoë Sturdy
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Contacts – Australia / SE Asia

- **Australian Urethane Systems**
- Roy Chowdhury
- 25 Garling Rd
- Kings Park NSW 2148
- TEL:(+1300) 304 522



Contacts - ROW

- **FOAM SUPPLIES INC**
- Todd Keske
- 4387 North Rider Trail
- Earth City, MO 63045
- USA
- TEL: 314-344-3330





ecomate[®]
BY FOAM SUPPLIES, INC.

The Next Generation Blowing Agent
